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㊹鋳造品の加熱方法と装置

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明　細　書

1. 発明の名称

鋳造品の加熱方法と装置

2. 特許請求の範囲

(1) 鋳型砂が付着している状態の鋳造品を、炉内のO_2濃度が17%乃至21%であり、熱風が強制的に炉内で循環されていて、間接加熱方式の発熱体を設けた焼入炉内に供給し、該鋳造品は該焼入炉内の循環する高温の熱風によつて焼入温度まで加熱されると同時に循環する高温の熱風とO_2の存在により鋳型砂を固めているバインダーを劣化させ、その接着力を失わせて鋳造品から鋳型砂を除去するようにした焼入炉における鋳造品の加熱方法。

(2) 鋳造品を焼入炉3の入口2から出口4まで搬送する搬送手段5を設け、該焼入炉内に1基または数基の間接加熱方式の発熱体8，8′，8″……を設け、該焼入炉内において熱風を循環させる1基または数基の循環用送風機9，9′……を設け、該焼入炉の底部に鋳造品から落ちた砂を外部へ運び去る砂搬出手段10，11を設けた鋳造品の加熱装置。

3. 発明の詳細な説明

本発明は鋳造品を焼入炉へ供給し、単に該鋳造品をその焼入温度まで加熱するだけでなく、該鋳造品に付着している鋳型砂を除去する鋳造品の加熱方法およびその方法を行なう加熱装置に関する。

鋳造品は一般に鋳型から取出された後に焼入炉に供給されて焼入温度まで加熱され、次に焼入槽に供給されて焼入され,次に焼戻炉に供給されて焼戻温度まで加熱される一連の熱処理工程を経た後に製品として使用される。

アルミ鋳造品たとえばシリンダーヘッドの場合も鋳鋼品同様に焼入と焼戻の熱処理を必要とし、このような熱処理を経た後に製品として使用される。従来は鋳造機から取出したばかりの鋳造品には鋳型砂が付着しているか

ら第4図に示すごとく従来は熱処理工程の前に鋳型砂を除去する工程があつた。鋳型砂の除去は従来種々の方法があるが、鋳造品が大量生産である場合は焼炉によつて鋳型砂の除去をすることがしばしば採用される。かように砂焼炉を用いて鋳型砂の除去をするときは、あらかじめ鋳型砂を固めるバインダーは熱とO_2の存在によつて熱分解され劣化されて鋳型砂を固める力が失われ、鋳造品に付着している鋳型砂が脱落されやすくなる性質のバインダーが採用される。

砂焼炉による砂除去は鋳造品はコンベヤに載せられて該砂焼炉の入口から出口まで搬送され、該砂焼炉の天井に数基のバーナを設け、これらバーナから噴出される火炎が該搬送される鋳造品にあてられて付着砂が落される方式であるが、各バーナへの空気の供給を過剰にして吹付けられる火炎中にO_2濃度が15%程度であるようにすればバインダーの劣化が促進させる。しかしながら火炎中にO_2を15%存在させることはなかなか困難であり、もしO_2濃度を10%程度にすれば鋳造品から鋳型砂を落すのに濃度15%の場合よりもはるかに長時間を必要とする。すなわち、鋳造品は該砂焼炉内に長時間滞在させなければならず、このことは大型の砂焼炉を必要とし、かつ大量の燃料を消費することとなる。また砂焼炉から排出される排ガス量も大量であつて、該排ガスとともに大量の熱エネルギーが奪てられるだけでなく、該排ガス中に砂が含有されているからこれをそのまま排出させることができず、排ガス中の砂の除去装置を通した後に排煙しなければならず、従つて排ガス中の砂除去も大装置を必要とする。

本発明は鋳型から取出した直後の鋳造品を、第5図に示すごとく、直ちに焼入炉へ供給して熱処理工程を行う。鋳型から取出した直後の鋳造品が未だあまり冷えておらず、高温であればそれだけ熱エネルギーの節約となる。本発明の焼入炉は単に鋳造品をその焼入温度まで加熱するだけでなく、同時に鋳造品に付着している鋳型砂を該焼入炉内において除去するものであるから、前述の第4図に示した砂焼炉工程を省くことができ、工程の短縮化、装置の簡単化、燃料の節約、省力化を同時にかつ大巾に達成するものである。

本発明で使用する焼入炉は、その加熱方式が従来の炉内にバーナによつて燃焼ガスを吹込む直接的な加熱方式と異り、たとえばラジアントチューブによる加熱あるいは電気ヒータによる加熱など炉内に間接加熱方式の発熱体を設け、また循環用送風機を設けて炉内で熱風が強制的に循環される。熱風の循環経路に発熱体が設置されているから熱風は該発熱体の熱を受けて鋳造品に熱を授ける加熱方式である。この加熱方式によつて炉内のO_2濃度を17%乃至21%の高レベルに保つことができ、従つて該焼入炉内に供給された鋳造品は主として炉内の熱風によつて所定焼入温度まで均熱に加熱されると同時に循環する熱風の高温と極めて高濃度のO_2の存在によつて前述の砂焼炉の場合よりも極めて迅速に鋳型砂を固めているバインダーを劣化させ、その接着力を失わせて鋳造品から鋳型砂を脱落させる加熱方式および加熱装置である。該焼入炉を出た鋳造品を直ちに焼入槽に供給し、熱入処理することができる。

本発明に係る焼入炉の実験は、主としてアルミ鋳造品であるシリンダーヘッドについて行つた。アルミシリンダーヘッドの場合はその焼入温度を480℃乃至530℃に設定し、炉内のO_2濃度を17%乃至21%にして試験をした結果アルミシリンダーヘッドの表面の砂だけでなく中子砂まで除去でき、該シリンダーヘッドは1時間で焼入温度まで均一に加熱され、同時に砂の除去も果せるがO_2濃度を15%以下に低下させると鋳型砂を落すのに長時間を要し、焼入温度までの加熱時間と一致させることができず、燃料の不経済になることが判明した。

本発明を、そのアルミシリンダーヘッドの焼入の実施例を示した第1図、第2図、第3図によつてさらに詳細に説明する。

第1図において、アルミシリンダーヘッドはバスケット1，1′，1″……内にそれぞれ1個または数個づつ収容され、先づ焼入炉入口前の供給テーブル2上に供給される。アルミシリンダーヘッドは鋳造機から取出された直後で、あまり冷えておらず、高温な状態である。高温であるほど熱エネルギーが節約される。この場合シリンダーヘッドに鋳型砂、中子砂が付着している状態で供給される。

本焼入炉3はその外側を軟鋼板で囲い内側をステンレス鋼板で囲い、両鋼板間に断熱材が充填されている。

バスケット1は供給テーブル2から焼入炉3内に入り排出テーブル4に取出されるが、バスケットを一定速度で積極的に搬送するためたとえば従来公知のハースローラ5，5′……などの搬送手段が設けられている。該焼入炉の入口と出口にそれぞれ一定時間ごとに自動的に昇降されるようにして入口扉6と出口扉7が設けられている。

本焼入炉3内には従来の直火焚きバーナによる燃焼生成ガスを被処理物にあてて直接的に加熱する焼入炉と異り、1基または数基のラジアントチューブ8，8′……が設けられている。また本焼入炉3内には1基または数基の循環用送風機9，9′……が設けられている。従つて炉内で、第3図に矢印で示すごとく熱風が強制循環される構造になつている。循環する熱風はその循環経過に設けたラジアントチューブ表面に接して熱を受けて高温の熱風となり、該熱風はバスケット内に流入してシリンダーヘッドに接して熱を授け、従つてシリンダーヘッドはこの循環熱風によつて比較的均一に加熱され昇温される。またかような加熱方式にすることによつて炉内のO_2濃度を17％乃至21％に保つことが容易である。かように高温でありかつ高O_2濃度である循環熱風をシリンダーヘッドにあてれば鋳型砂を固めているバインダーは短時間で変化し、その接着力が失われるからシリンダーヘッドから容易に鋳型砂や中子砂を落すことができる。本焼入炉のハースローラ5，5′……の下方に一基または数基のホッパー10，10′……およびスクリュフイダー11，11′…… よりなる砂搬出手段が設けられている。

バスケット1″は焼入炉3の出口扉7から出ると排出テーブル4上に載せられるが、該排出テーブル4はエレベーター機構12の一部になつていて、バスケット1″は該エレベーター機構12の底部に設けた焼入槽13内に浸漬され焼入処理が行われる。

第1図乃至第3図に示す焼入炉3においては循環熱風の経路にラジアントチューブを発熱体として設けているがラジアントチューブの代りに電熱器を用いて熱風を加熱し、アルミシリンダーヘッドを加熱することができる。この場合も炉内におけるO_2濃度を17％乃至21％に保つことが容易である。ラジアントチューブや電熱器などはバーナ火炎を直接的に被加熱物にあてる直接的な直火焚加熱方式に対し間接加熱方式ということができる。

本発明に係る焼入炉3はラジアントチューブ8など間接加熱方式の発熱体を採用することによつて炉内のO_2濃度を17％乃至21％に維持することが容易であり、鋳造品を焼入温度にまで加熱する時間内で鋳造品から鋳型砂や中子砂を落すことができる。落された砂は循環熱風の経路から外れてホッパー10の底に溜り、この沈澱した砂をスクリュコンベヤ11によつて容易に外に取出すことができ、かつ炉内の熱風は該沈澱砂によつてシールされて外部に噴出されない。

本発明に係る焼入炉はさきに述べた砂焼炉など鋳造品から鋳型砂を落す工程を省くことができる。鋳造品を比較的均一に焼入温度まで加熱することができる。鋳造機から取出した直後の鋳造品を供給テーブルに供給して熱

入炉における鋳造品加熱用の熱エネルギーの節約をすることができる。すなわち工程の短縮化、装置の簡単化、燃料の節約省力化を同時にかつ大巾に達成することができる。

上述の説明においては実施例をアルミシリンダーヘッドの焼入について述べたが、本発明はアルミシリンダーヘッド以外のアルミ鋳造品にも適用することができ、また本発明はアルミ鋳造品だけでなく鋳鋼品にも適用することができる。

4.図面の簡単な説明

第1図、第2図、第3図はいづれも本発明に係るアルミシリンダーヘッドの焼入炉のそれぞれ側断面図、平面図、III－III断面図である。

第4図は従来の鋳造品の焼処理工程までの工程図、第5図は本発明の加熱方法および加熱装置における熱処理工程までの工程図を示す。

1はバスケット、2は供給テーブル、3は焼入炉、4は排出テーブル、5はハースローラ、6は入口扉、7は出口扉、8はラジアントチューブ、9は循環用送風機、10はホッパー、11はスクリューフィダー、12はエレベーター機構、13は焼入槽。

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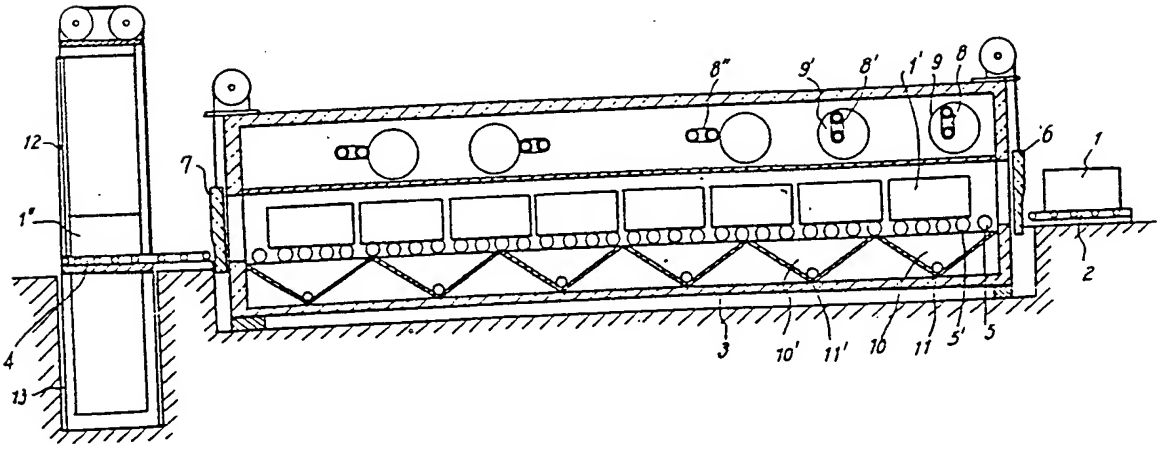
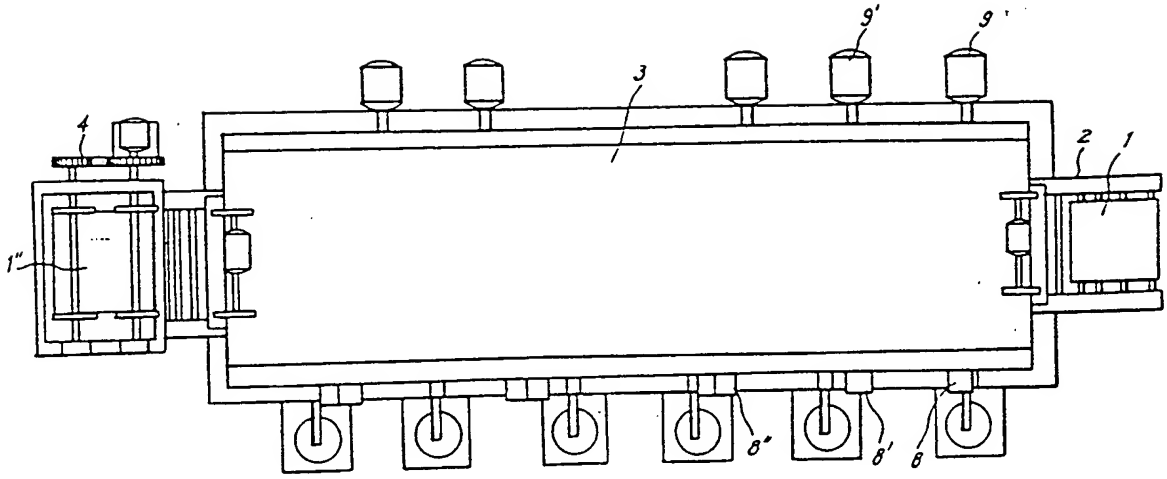
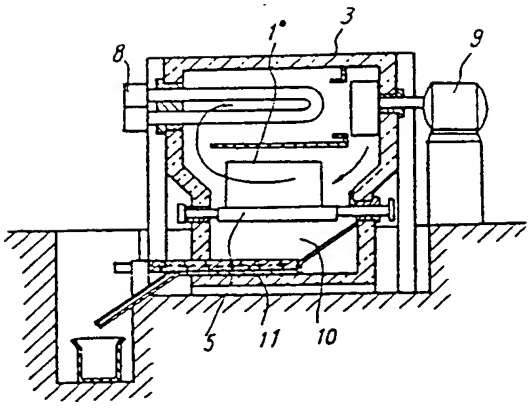
第1図



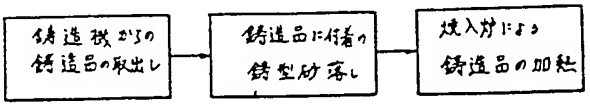
第２図



第３図



第４図



第５図

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METHOD AND DEVICE FOR HEATING OF CASTING

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ABSTRACT

PURPOSE: To remove molding sand from castings with a simple device and stages by supplying the castings stuck with the molding sand into a hardning furnace, and circulating hot wind therein thereby allowing the binder solidifying the sand to evaporate.

CONSTITUTION: Castings of Al or the like in a high temperature state are contained in baskets 1 and are supplied into a hardening furnace 3. Hot wind is forcibly circulated from a circulating fan 9 provided with heating elements such as radiant tubes 8 provided in the furnace 3. Further, the concentration of O(sub 2) in the furnace 3 is maintained at about 17-21%. The castings are heated uniformly by the circulating hot wind, and the binder solidifying the molding sand evaporates quickly, and loses the adhesive power. Thus the molding sand and core sand drop easily from the castings and are carried out by means of a hopper 10 and a screw feeder 11.

(1) Japanese laid open patent application 58-25860

1. Title of the invention

Method and device for heating of casting

2. Claims

(1) A method for heating of a casting, comprising providing a casting with molding sand stuck thereon into a solution furnace which is provided with an indirect heating type of heater and within which O_2 concentration is from 17% to 21% and a hot wind is forcibly circulated, heating the casting to a solution temperature by the circulated hot wind of high temperature, and at the same time, evaporating a binder binding the molding sand by the circulated hot wind of high temperature and existence of O_2, so as to loose adhesion thereof and drop the molding sand from the casting.

(2) A device for heating of a casting, comprising conveying means 5 for conveying the casting from an entrance 2 to an exit 4 of a solution furnace 3, one or more indirect type of heaters 8, 8′, 8″,... provided within the solution furnace, one or more circulating fans 9, 9′, 9″,... provided for circulating a hot wind within the solution furnace, sand conveying means 10, 11 provided at a bottom of the solution furnace for conveying out sand fallen from the casting.

3. Detailed description of the invention

The present invention relates to a method and a device for heating a casting which not only heats the casting provided into a solution furnace to its solution temperature, but also removes the molding sand stuck on the casting.

Generally, a casting taken out from a mold is provided into a solution furnace to be heated to a solution temperature, provided to a quench tank to be quenched, and then provided into an aging furnace to be heated to an aging temperature. After being subject to these series of heat treatments, the casting is used as a product.

An aluminium casting, such as a cylinder head, also requires a heat treatment of solution and aging as well as a steel casting, and is used as a product after such a heat treatment. Conventionally, as molding sand is stuck on a casting which is just

taken out from a mold, there was a process for removing the molding sand prior to heat treatment processes, as shown in Figure 4. Several methods are conventionally available to remove molding sand. Where a casting is mass-produced, a method which uses a sand burning furnace is often used to remove molding sand. Where molding sand is removed by using such a sand burning furnace, a binder is chosen for binding molding sand to have characteristics of heat resolvable with heat and existence of O_2, so as to be evaporated and loose effects of binding molding sand, resulting in an easy fall of molding sand stuck on the casting.

The method of removing molding sand by a sand burning furnace is such that a casting product is mounted on a conveyer and conveyed from the entrance to the exit of the sand burning furnace, a ceiling of which is provided with several burners, and the flame from the burners is applied to the casting so that the sand stuck is dropped. If air provision to each burner is made to excess so as to make concentration of O_2 in the flame about 15%, the evaporation of the binder will be accelerated. However, it is difficult to make O_2 in the flame 15%. If O_2 concentration is about 10%, it takes much longer time than in the case of 15% concentration to fall molding sand from the casting. That is, the casting must stay in the sand burning furnace for a long time, which means that a big sand burning furnace is required, and a large quantity of fuel will be consumed. Moreover, the amount of discharged gas which is discharged from the sand burning furnace is also large, a large amount of heat energy is abandoned with the discharged gas. As the discharged gas contains sand, it should not be discharged directly and should be passed a device for removing the sand from the discharged gas prior to the discharge. Accordingly, a big device is needed for removing sand from the discharged gas.

In accordance with the present invention, a casting taken out from a mold is, as shown in Figure 5, immediately provided into a solution furnace to carry out heat treating processes. Higher temperature is the casting which is just taken out from the mold and which is not yet significantly cooled down, more heat energy is saved. The solution furnace in accordance with the present invention not only heats the casting to its solution temperature, but also removes the molding sand stuck on the casting at the same time within the solution furnace. Accordingly, as the process of burning

the sand as shown in Figure 4 can be eliminated, shortening of the processes, simplifier of the machines, saving of fuel, and economical use of energy are simultaneously and significantly achieved.

In the solution furnace used in the present invention, the method of heating is different from the conventional one in which combusted gas is directly brown into the furnace by burners. In the solution furnace used in the present invention, indirect heating types of heaters are provided within the furnace, such as radiant tubes or electrical heaters, and circulating fans are provided so that a hot wind is forcibly circulated in the furnace. As a heater is provided in a circulation path of the hot wind, the hot wind receives the heat from the heater and provides the heat to the casting. Such a heating method enables maintenance of the O_2 concentration in the furnace at a high level of 17% to 21%. Accordingly, the casting provided in the solution furnace is heated to a predetermined solution temperature mainly by the hot wind within the furnace, and at the same time, the binder binding the molding sand is evaporated much quicker than in the aforementioned sand burning furnace, by the high temperature of the circulated hot wind and the existence of highly concentrated O_2. The binder looses its adhesion and the molding sand is fallen from the casting. The casting exited from the solution furnace is immediately provided to a quench tank, thus the solution treatment is carried out.

Experiments of a solution furnace in accordance with the present invention were carried out for mainly cylinder heads as aluminium castings. Aluminium cylinder heads were experimented in a condition that the solution temperature was set to 480°C - 530°C and the oxygen concentration within the furnace was made to 17% - 21%, resulting in the removal of molding core sand as well as the molding sand stuck on the surface of the aluminium cylinder heads. The cylinder heads were evenly heated to the solution temperature in one hour. It was revealed that, when the O_2 concentration was lowered on or below 15 %, it took longer time to remove the molding sand though the removal of the sand was possible. Accordingly, the time could not be made the same as the heating time for bringing up to the solution temperature, resulting in uneconomical use of the fuel.

The present invention is described in detail referring to Figures 1, 2, and 3 which show an example of solution of aluminum cylinder heads.

Referring to Figure 1, aluminium cylinder heads are accommodated one by one or some together in baskets 1, 1', 1",..., and provided on the providing table 2 in front of the entrance of a solution furnace. The aluminium cylinder heads are just taken out from a molding apparatus and not yet significantly cooled down and still at a high temperature. Higher temperature are the heads, more heat energy is saved. The cylinder heads are provided with the molding sand and core sand stuck thereon.

The solution furnace 3 is surrounded with a soft steel board outside of the furnace and a stainless steel board inside thereof, and a heat insulator is filled between the steel boards.

Basket 1 is entered from providing table 2 into solution furnace 3 and taken out to exit table 4. In order to positively convey the baskets at a constant speed, provided is conveying means, such as conventional driven rollers 5, 5',.... The solution furnace is provided at the entrance and the exit with an entrance door 6 and an exit door 7 which are automatically lifted and dropped at a predetermined interval.

In the solution furnace 3 in accordance with the present invention, which is different from the conventional solution furnace which directly heats a treated subject with gas produced by a direct combustion burner, one or more radiant tubes 8, 8',... are provided. Within the solution furnace 3, one or more circulating fans 9, 9',... are provided. Accordingly, as shown with an arrow in Figure 3, a hot wind is forcibly circulated within the furnace. The circulated hot wind contacts the surface of radiant tubes provided in the circulating path thereof and receives the heat to become a hot wind of high temperature. The hot wind flows into the baskets and contacts with the cylinder heads to provide heat thereto. Thus, the cylinder heads are heated relatively uniformly and brought up to high temperature by the circulated hot wind. With such a heating method, it is easy to maintain the oxygen concentration within the furnace to 17-21%. By bringing the circulated hot wind which is high temperature and high oxygen concentrated in contact with the cylinder heads, the binder binding the molding sand evaporates in a short time and looses its adhesion, so that the molding sand and the core sand easily fall down from the cylinder heads.

Underneath of driven rollers 5, 5',... of the present solution furnace, provided is sand convey means comprising one or more hoppers 10, 10',... and screw feeders 11, 11',...

Basket 1" is mounted on exit table 4 when it exits from exit door 7 of the solution furnace 3. The exit table 4 is a part of an elevator mechanism 12, and basket 1" is immersed into quench tank 13 which is provided on the bottom of elevator mechanism 12, and thus the solution treatment is carried out.

In solution furnace 3 shown in Figures 1 to 3, the radiant tubes are provided as a heater in the path of the circulated hot wind. Electrical heaters may be used instead of radiant tubes to heat the hot wind and heat the aluminum cylinder heads. In this case, it is also easy to keep O_2 concentration within the furnace from 17% to 21%. It may be called an indirect heating method to use radiant tubes or electrical heaters, in opposite to a direct combustion heating method which uses burner flame directly contacting to heated subjects.

In solution furnace 3 in accordance with the present invention, it is easy to maintain O_2 concentration within the furnace from 17% to 21% by using heaters of the indirect heating type such as radiant tube 8. During the time of heating the casting to the solution temperature, molding sand and core sand can be fallen from the casting device. The fallen sand is flown out of the path of the circulated hot wind and deposited in the bottom of hopper 10. The deposited sand is easily conveyed out by screw conveyer 11, and the hot wind within the furnace is sealed in with the deposited sand and prevented from blowing out.

The solution furnace in accordance with the present invention can eliminate a step of dropping the molding sand from the casting by such as the aforementioned sand burning furnace. The casting can be relatively uniformly heated to the solution temperature. Heat energy for heating the castings within the solution furnace can be saved by immediately providing the casting taken out of the molding apparatus to the providing table. That is, shortening of the processes, simplifier of the machines, saving of fuel, economical use of energy are simultaneously and significantly achieved.

In the above description, the embodiment was explained for the solution of aluminium cylinder heads. The present invention may be applied to aluminium casting other than cylinder heads, and also to steel castings.

4. Brief description of the drawings

Figures 1, 2, and 3 are respectively a side cross-sectional view, plan view, III-III cross-sectional view of a solution furnace for aluminium cylinder heads in accordance with the present invention.

Figure 4 is a process diagram showing the conventional heating treatment processes of castings. Figure 5 is a process diagram showing the heating treatment processes of castings in accordance with the present invention.

1 is a basket, 2 is a providing table, 3 is a solution furnace, 4 is an exit table, 5 is a driven roller, 6 is an entrance door, 7 is an exit door, 8 is a radiant tube, 9 is a circulating fan, 10 is a hopper, 11 is a screw feeder, 12 is an elevator mechanism, and 13 is a quench tank.